(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 464 803 A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 91111051.8

(22) Date of filing: 03.07.91

(51) Int. Cl.[5]: D03D 15/00

Ein Antrag gemäss Regel 88 EPÜ auf Berichtigung des Anspruches 4 liegt vor. Über diesen Antrag wird im Laufe des Verfahrens vor der Prüfungsabteilung eine Entscheidung getroffen werden (Richtlinien für die Prüfung im EPA, A-V, 2.2).

(30) Priority: 05.07.90 US 548240

(43) Date of publication of application: 08.01.92 Bulletin 92/02

(84) Designated Contracting States: AT BE CH DE ES FR GB IT LI NL SE

(71) Applicant: Bay Mills Limited
39 Seapark Drive
St. Catharines, Ontario L2M6S(CA)

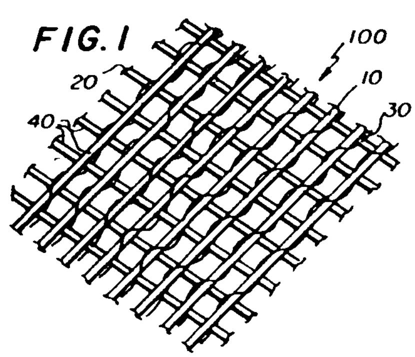
(72) Inventor: Porter, John F.
20 Tavistock Rd., St. Catharines
Ontario 2LM 6Y1(CA)
Inventor: Kittson, Mark O.
656 Algonquin Dr., Midland
Ontario(CA)

(74) Representative: Melzer, Wolfgang, Dipl.-Ing. et al
Patentanwälte Dipl.-Ing. H. Mitscherlich
Dipl.-Ing. K. Gunschmann Dipl.-Ing.
Dr.rer.nat. W. Körber Dipl.-Ing. J.
Schmidt-Evers Dipl.-Ing. W. Melzer
Steinsdorfstrasse 10
W-8000 München 22(DE)

(54) Reinforcement for wall systems.

(57) A method of making an open grid weft inserted warp knit reinforcement fabric (100) having a soft hand for reinforcing wall systems is disclosed. First and second sets of substantially parallel ends are arranged in an overlying relation at a substantial angle to one another. The yarns (10, 20) of the first and second sets preferably have a linear density between 100 and 2000 grams per thousand meters and are arranged at an average of 3 to 10 ends per inch. The first and second sets of yarns (10, 20) are affixed together by weft insertion warp knitting with tie yarn (30) to form the open grid fabric (100) having a warp direction and weft direction. A polymeric coating is applied to the yarns (10, 20) at a level of 15 to 150 parts dry weight of resin (40) to 100 parts by weight of the fabric (100). A method for reinforcing a wall system and a wall segment product utilizing the novel fabric (100) of the present invention are also disclosed.

FIG. I



EP 0 464 803 A1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 11 1051

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US-A-4 522 004 (MICHAEL E. EVANS) * column 2, line 1 - line 39; figures 1-6 *	1,2,3,8, 16,17, 18,19,20	D03D15/00
Y	EP-A-0 131 954 (SUMITOMO RUBBER INDUSTRIES) * page 6, line 29 - page 7, line 19; figure 6 *	1,2,3,8, 16,17, 18,19,20	
A	US-A-4 320 160 (AKIRA NISHIMURA) * column 6, line 23 - column 8, line 40; figures 1-9 *	4,8,13, 14,15	
A	EP-A-0 290 653 (THOMAS JOSEF HEIMBACH) * page 3, column 4, line 19 - line 48; figures 1-3 *	1,2,3,8	
A	DE-A-1 123 266 (TECHNICQUE DU VERRE TISSE, PARIS) * column 1, line 40 - column 2, line 30; figures 2,3 *	1,2,3,8	TECHNICAL FIELDS SEARCHED (Int. Cl.5) D03D D04B
A	US-A-4 578 915 (JOSEPH W. SCHNELLER) * column 1, line 45 - column 2, line 19; figures 1-3 *	17,18, 19,20	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 OCTOBER 1991	HENNINGSEN O.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a fabric for reinforcing stucco layers on walls, particularly on foam insulation board on walls. The fabric has high strength, a soft hand and alkali resistance. The fabric is resin-bearing, made by weft insertion warp knitting, and takes the form of a grid with openings between the strands. The present invention also relates to a method of making such reinforcement fabric, to a method for reinforcing such wall systems, and to a wall segment that utilizes the novel reinforcement disclosed herein.

Description of the Related Art

A popular method of constructing walls comprises a wall system in which a rigid plastic foam insulation board is bonded to a concrete or other wall. The insulation board is covered with a layer of reinforcement fabric imbedded in a stucco or stucco-like material. The fabric may be initially attached to the insulation board mechanically with staples, nails, screws or the like. Alternatively, the fabric may be attached to the insulation board by means of an adhesive spread onto the insulation board. The stucco-like material, which is often referred to as a base coat, is typically a polymer modified cement containing for example Portland cement and an acrylic or other polymer or copolymer. During fabrication of the wall system, the fabric is buried in the stucco-like material. The openings in the fabric permit the stucco-like material to be pushed through the fabric and contact the insulation board. The stucco-like layer with reinforcement fabric buried in it may range from about 1/16 inch to 1/4 inch thick. Finally, a finishing coat is usually placed on top of the base coat to provide, among other things, better appearence and perhaps better weather resistance.

In such wall systems a wall segment may be prepared either in situ on the outside of a building or in the form of prefabricated panels.

A primary purpose of the reinforcement fabric in these systems is to provide the wall with impact resistance for durability. The reinforcement fabric must, however, have several performance and application requirements: (1) the reinforcement should be economical; (2) the reinforcement should be as light in weight as possible; (3) the reinforcement should greatly increase the impact resistance of the wall system; (4) the reinforcement should provide some resistance to shrinkage cracking, which occasionally occurs in, for example, polymer modified cement stucco materials; (5) the fabric should confer vibration resistance to the wall; (6) performance of the reinforcement should not deteriorate significantly over an extended period; (7) for purposes of installation, the reinforcement should have applied thereto a resin which gives the reinforcement a "hand" or "limpness" to conform to changes in the profile of the wall (for example, at corners or bends), but the reinforcement should not be so limp as to "bunch up" or fold during trowelling of stucco thereon, nor should resin on the reinforcement be so soft that the fabric sticks to itself on the roll before installation (a phenomenon known as "blocking"); and (8) the reinforcement must have enough integrity to prevent distortion or dislodging of the yarns during handling and covering with stucco or stucco-like material.

Typically in the prior art, coated fabrics have been used as the reinforcement in wall systems, but these fabrics have been woven fabrics, manufactured using standard weaving technology and a conventional weave, such as a plain weave with looper yarns, hurl leno weaves and leno weaves. Non-woven scrims of the kind held together solely by adhesive resin have also been used, but to a lesser extent. Leno weave is a weaving process in which warp yarns are arranged in pairs and fill yarn is shot straight across the fabric as in a plain weave, but the warp threads are alternately twisted in a left hand and right hand direction, crossing before each pick is inserted. Examples of the prior art fabrics are shown in Figs. 2 through 4. An example of a leno weave is shown in Fig. 2. An example of a hurl leno weave is shown in Fig. 3 and an example of a plain weave with looper yarns is shown in Fig. 4.

These prior art reinforcement fabrics have typically been composed of glass yarn or roving wherein the individual warp yarns are generally lighter in weight and weaker in strength than the weft yarn or roving. In this way, the strength of each pair of warp yarns is comparable to that of the individual weft yarns or rovings.

Such conventional reinforcements are generally referred to as "scrim" in U.S. Patent 4,522,004, "woven glass fiber scrim" in U.S. Patent 4,525,970, or "open-weave mesh" in U.S. Patent 4,578,915.

We have discovered, however, that it is possible to achieve results comparable to those achieved by the prior art but using significantly less weight of yarn in the fabric, with consequent economies and reduced weight in the final wall. Alternatively, with the reinforcement of our invention, at comparable weight and cost, one is able to achieve greater strength, durability and impact resistance.

Accordingly, it is one object of the present invention to produce an improved fabric for reinforcing wall systems.

It is another object to reinforce a wall system and to provide a wall segment that utilizes the improved fabric of the present invention.

These and other objects that will become apparent may be better understood by the detailed description provided below.

SUMMARY OF THE PRESENT INVENTION

The present invention relates to a new reinforcement fabric for wall systems, to a method of making that reinforcement, to a method for reinforcing walls with that reinforcement, and to wall segments made with that reinforcement. In making the reinforcement, a first set of substantially parallel yarns running in a first direction, and a second set of substantially parallel yarns running in a second direction, are arranged in an overlying relation at a substantial angle to one another. The first and second sets of yarns are affixed together by weft insertion warp knitting loosely with affixing or tie yarn to form an open grid fabric. A polymeric resin is applied to the yarns at a level of 10 to 150 parts dry weight of resin to 100 parts by weight of the fabric. That is, resin is applied at 10% to 150% DPU (dry-weight pick up). The resulting reinforcement is a high strength, soft hand, alkali resistant, resin-bearing open grid weft inserted warp knit fabric including first and second sets of substantially parallel yarns affixed together at a substantial angle to one another by loosely tensioned affixing yarns and the resin.

The present invention includes securing the reinforcement to a wall and applying a coating of a stucco-like mixture to fill openings in grid, and cover the grid. The invention may be used in situ or in prefabricated wall segments. In a wall segment the invention may be imbedded in a stucco-like coating mixture and combined with a rigid insulation board. In this embodiment, the mixture and reinforcement are affixed to the board. "Stucco" is used in this specification to include any stucco-like material or coating such as polymer modified cements currently used in the reinforced wall systems referred to above.

The fabric of this invention exhibits superior performance and ease of application at a lower cost as compared to prior reinforcements for wall systems.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of fabric utilized in the present invention.

Figure 2 shows a perspective view of a leno woven fabric according to the prior art.

Figure 3 is a perspective view showing a hurl leno woven fabric according to the prior art.

Figure 4 is a perspective view showing a plain woven fabric with looper yarns according to the prior art.

Throughout the Figures the same reference numerals designate the same or corresponding parts.

DETAILED DESCRIPTION OF THE INVENTION

The fabric of the present invention is depicted in Figure 1. The fabric 100 essentially occupies two planes. The warp or machine direction yarns or rovings 10 occupy and define one plane, and the weft or cross machine direction yarns or rovings 20 occupy and define a second plane. These yarns are tied together in a knitting process in which the knitting or tie yarn 30 is a lightweight flexible yarn wrapping the warp yarns and capturing the weft yarns. Figure 1 is not intended to show precisely the path of knitting yarn 30; the exact paths possible, which will vary depending on the machine and stitch used, are well known to those of skill in the art. The fabric 100 is further locked together by a polymeric resin 40. The particular resin 40 must be chosen for compatibility with the particular yarns, and with the finishes on those yarns, and for the best properties in the final wall system, but those of skill in the art can determine which resin is best for a given yarn and finish. The two-plane construction of the reinforcement of this invention minimizes the crimp or bending of the yarns or rovings, which is an advantage over prior art reinforcements in which the yarns are kinked or crimped as they zig-zag between the three planes involved in those prior art constructions. In addition, minimal crimp allows better penetration of the polymeric resin 40.

An example of the fabric construction of the present invention is a weft inserted warp knit product having approximately six ends per inch in both the warp and weft directions, but possibly as few as 1.5 ends in each direction and as many as 12 ends in each direction. Preferably, the ends of the first and the second sets are arranged in each set at an average of 3 to 10 ends per inch.

As used herein, the term "yarn" refers to light weight bundles of filaments, usually having some twist, as well as to rovings, which are heavier, sometimes approximately ten times heavier per unit length than

yarn, and have substantially no twist. The term "ends" refers to a single yarn or a group of yarns combined together to make a single strand in the final grid. The warp and weft yarns of fabric 100 may have a linear density of 33 to 2000 Tex (grams per thousand meters). Preferably, the yarns of the first and the second set have a linear density between 100 and 2000 Tex and most preferably, 130 to 400 Tex. The weight and strength of the yarns selected depends on the performance range desired. The features of the particular yarn, including filament diameter and the type and level of chemical sizing on the yarn before knitting, may be selected by those of skill in the art in accordance with the desired properties for the particular end use. Although fiberglass yarns are preferred, others such as nylon, aramid, polyolefin and polyester may be used in various combinations.

The ends 10 of the first set and the ends 20 of the second set are arranged in an overlying relation and at a substantial angle to one another. This angle may be on the order of ninety degrees. However, it is not necessary to orient the ends of the first and second sets orthogonally. Rather, this angle may vary between sixty and one hundred twenty degrees or more.

The knitting yarn 30, which is typically a low weight polyester tie yarn in the linear density range of 40 to 200 dTex, may preferably be knit in a chain stitch. Other suitable tie yarns may be nylon, olefin, acrylic, modacrylic, rayon, acetate, polyvinyl chloride, polyvinyl dichloride, or polyvinyl difluoride.

Preferably, knitting is done with a chain stitch and a loose tension on the knitting yarn. A preferable loose tension for fabrics with a preferable number of ends per inch (4 to 8 ends in cross-machine direction) and with a preferable weight of structural yarns (130 to 400 Tex), is at least about 3.1 yards of knitting yarn for every one yard of ends 10 in the warp direction. A standard tension with this kind of fabric is about 3 yards of knitting yarn for every one yard of ends 10 in the warp direction. If one increases this ratio to 3.1 to 1 the result is essentially no tension, or as little tension as possible without creating open loops in the knitting yarns, which may occur at a ratio of 3.3 to 1. This loose knitting is believed to be important because it permits the polymer resin when applied in later processing to penetrate the warp yarn more uniformly and deeply. Breakage of warp yarns is frequently a source of failure in these wall systems.

The fabric 100 typically has applied to it a polymer or polymer blend resin 40 to confer properties to the fabric such as stability, alkali resistance, and strength improvement to the reinforcement. The glass transition temperature of the resin is important to the present invention for providing the desirable soft hand of the fabric. A soft hand is preferred. However, an overly soft fabric has the tendency to stick to itself on a roll. This is known as blocking. In the present invention, for any given weight of yarn "hand" is primarily determined by the glass transition temperature characteristics of resin applied to the reinforcement. The glass transition temperature of the resin of the present invention is typically in the range of -30°C to +20°C, but may extend from -40°C to +40°C. The resin selected is preferably flame retardant. It is also preferable to use alkali and water resistant resins, such as those consisting of polyvinyl chloride, styrene butadiene rubber, acrylic and styrene acrylate polymers and copolymers.

The resin 40, when applied in or above the preferred range of 25 to 40% dry weight pick-up, increases integrity of the fabric by preventing yarn-to-yarn slippage and assists the fabric in resisting alkali damage. The resin may be applied to the fabric by coating or dipping techniques. In standard, woven reinforcement fabrics of the prior art, resin is applied at the rate of about 15 to 20% dry weight pick-up ("DPU"). In standard, non-woven reinforcements DPU's of 100 to 120% are typically used because the resin is required to hold the fabric together. In the reinforcement of the present invention, the most preferred resin amount to use is 25 to 40 DPU, and 10 to 80 DPU is less preferred. We have found that resins, when used in the preferred range (i.e., about double the amount used on standard woven reinforcements), improve impact resistance by spreading the force of the impact out among adjoining structural fabrics. Weights of resin from 80 to 150 DPU are also possible, though economics may become a factor when such large amounts are used.

As will be appreciated by those of skill in the art, one may adjust the various process variables, both in knitting and in applying resin, to alter the performance and processability of the final fabric. For example, using a loose tie yarn tension in the knitting process and using contact drying following the resin application process, will render the fabric thinner than otherwise and improve the "hand" or suppleness of the fabric.

The present invention has several advantages over current reinforcement fabrics, as shown by the following table:

Property	Present Invention Ex. #1	Present Invention Ex. #2	Leno Woven	Hurl Leno Woven	Nonwoven Scrim
Relative Cost	0.85	1.0	1.0-1.4	1.2-1.6	1.2-1.8
Impact (in-lbs.)	12-16	32-36	12-16	28-32	28-36
Ends/In, MD	6	6	6	6	5.5
CD	5.5	5.5	6	5	5.5
Area Wt. (g/m^2)	170	180	160	200	240
Tensile MD	200	275	170-200	280-300	250-290
(lbs/in) CD	230	315	230-260	300-320	280-320
Hand	SOFT	SOFT	SOFT	SL. FIRM	SL. FIRM
Block Resistance	GOOD	GOOD	GOOD	GOOD	FAIR-GOOD

"MD" refers to machine direction, i.e., warp. "CD" refers to cross-machine direction, i.e., weft. "Impact" refers to the pounds of impact the wall system will resist without significant denting in a standard test. "Area weight" is the weight of reinforcement yarns per unit area. "Ends/In" refers to the number of ends per inch; in leno, hurl leno and some non-woven fabrics, a single end and may consist of two or more yarns.

As shown by an analysis of the above results, the reinforcement fabrics of the prior art are inferior in at least one of the attributes noted above. Their designs may be slightly altered to improve one property, but it occurs at the expense of another. For example, the hand of the nonwoven scrim may be improved from slightly firm to soft (by using a softer coating), but only at the expense of block resistance. Also, by comparison, the fabric labelled "hurl leno woven" is stronger than "leno woven". However, the cost and the stiffness (hand) of the fabric must be increased as a compromise to so increase strength.

The principal factor affecting both strength and cost is the weight of the yarn and the number of yarns per inch, which together result in an "area weight." The difference between the fabric labelled as present invention Example #1 and Example #2 is in the weight of the yarns used. The heavier the yarn, the stronger the fabric, albeit at increased cost. Within any one construction type, those skilled in the art will find that additional processing variables may be altered to improve performance, but these additional variables do not have as much influence as the particular construction used. These additional variables include the filament diameter, the sizing present on the yarn before weaving or knitting, and the type, amount, and degree of penetration of the resin applied to the fabric after it is formed. We have found that these factors vary among the various construction types in the magnitude of their influence on impact resistance.

The processes and products described herein are representative and illustrative of ones which could be used to create various reinforcement fabrics and wall segments in accordance with the instant invention. The foregoing detailed description is therefore not intended to limit the scope of the present invention. Modifications and variations are contemplated, and the scope of the present invention is intended to be limited only by the accompanying claims.

Claims

1. A method of making an open grid weft inserted warp knit fabric (100) having a soft hand for reinforcing wall systems, said method comprising the steps of:

   selecting a first set of substantially parallel yarns (10) running in a first direction, such yarns having a linear density between 33 and 2000 grams per thousand meters and being arranged in the set at an average of 1.5 to 12 ends per inch;

   selecting a second set of substantially parallel yarns (20) running in a second direction, such yarns having a linear density between 33 to 2000 grams per thousand meters and being arranged in the set

at an average of 1.5 to 12 ends per inch;

arranging the first and second sets of yarns (10, 20) in an overlying relation at a substantial angle to one another;

affixing the first and second sets of yarns (30) together by weft insertion warp knitting with tie yarn to form the open grid fabric; and

applying to the yarns a polymeric resin (40) at a level of 10 to 150 parts dry weight of resin to 100 parts by weight of the fabric (100).

2. The method of claim 1, wherein the affixing step comprises knitting the tie yarn (30) to the first and second sets of yarns (10, 20) at loose tension.

3. The method of claim 2, wherein the knitting step comprises knitting by chain stitch.

4. The method of claim 2 or 3, wherein the tension is at least about 3.1 yards of tie yarn for every 1 yard of ends in a warp direction.

5. The method of anyone of claims 1 to 4, wherein the resin (40) has a glass transition temperature between -40°C to +40°C.

6. The method of anyone of claims 1 to 5, wherein the glass transition temperature of the resin (40) is between -20°C to +15°C.

7. The method of anyone of claims 1 to 6, in which the resin is applied at a level of 25 to 40 parts dry weight of resin to 100 parts weight of fabric (100).

8. The method of anyone of claims 1 to 7, wherein the substantial angle is selected from between sixty to ninety degrees.

9. The method of anyone of claims 1 to 8, wherein the tie yarn (30) has a linear density between 40 and 200 grams per thousand meters.

10. The method of anyone of claims 1 to 9, wherein the yarns (10, 20) in the plurality of yarns running in the first and second directions have a linear density of 130 to 400 grams per thousand meters.

11. The method of anyone of claims 1 to 10, wherein the step of selecting the first set of yarns (10) and the step of selecting the second set of yarns (20) comprise selecting yarns (10, 20) from the group consisting of fiberglass, nylon, aramid, polyolefin, polyester, and mixtures thereof.

12. The method of anyone of claims 1 to 11, wherein the first set of yarns (10) and the second set of yarns (20) have a linear density of 100 to 2000 grams per thousand meters and are arranged at an average of 3 to 10 yarns per inch.

13. The method of anyone of claims 1 to 12, wherein the affixing yarn (30) is a low weight yarn selected from the group consisting of polyester, nylon, olefin, acrylic, modacrylic, rayon, acetate, polyvinyl chloride, polyvinyl dichloride and polyvinyl difluoride.

14. The method of anyone of claims 1 to 13, wherein the resin (40) applying step comprises applying a flame retardant resin.

15. The method of anyone of claims 1 to 14, wherein the resin (40) in the resin applying step is selected from the alkali and water resistant group consisting of polyvinyl chloride, styrene butadyne rubber, acrylic and styrene acrylate polymers and copolymers.

16. The method of anyone of claims 1 to 15, wherein the first set of yarns (10) comprise warp yarns lying in a first plane, the second set of yarns (20) comprise weft yarns lying in a second plane, the affixing step comprises tie yarn (30) for wrapping the warp yarns and capturing the weft yarns, and the resin (40) applying step comprises covering and impregnating the yarns of the first and second sets for increasing integrity of the fabric by preventing yarn-to-yarn slippage and for resisting alkali damage to

the fabric.

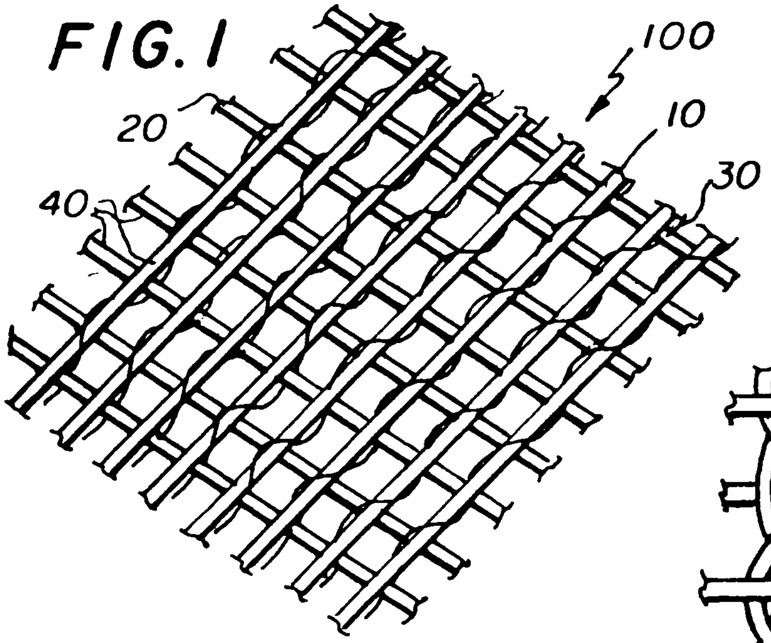
17. A method for reinforcing a wall system comprising the steps of:
securing a high strength, soft hand, alkali resistant, resin-bearing open grid weft inserted warp knit reinforcement fabric (100) comprising a first set of substantially parallel yarns (10), a second set of substantially parallel yarns (20), the two sets of yarns being affixed together at a substantial angle to one another by loosely tensioned tie yarns (30), and the resin (40) being present at a level of 15 to 150 parts dry weight of resin to 100 parts by weight of fabric (100); and
applying a stucco mixture to fill voids in and cover the fabric.

18. The method of claim 17, wherein said securing step comprises applying a layer of adhesive coating to the wall system and laying the fabric (100) flat over the adhesive coating.

19. A wall segment product comprising:
rigid insulation board;
a stucco-like coating mixture; and
a high strength, soft hand, alkali resistant, resin-bearing open grid weft inserted warp knit reinforcement fabric (100) comprising a first set of substantially parallel yarns (10); and a second set of substantially parallel yarns (20), the two sets of yarns being affixed together at a substantial angle to one another by loosely tensioned affixing yarns (30), and the resin (40) being present at a level of 15 to 150 parts dry weight of resin to 100 parts by weight of fabric (100),
the reinforcement fabric (100) being embedded in the coating mixture, and the coating mixture being affixed to the insulation board.

20. The wall segment product of claim 19, in which the segment is prefabricated before installation on a wall.

FIG. 1



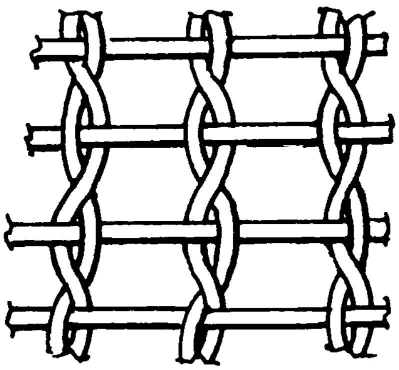


FIG. 2

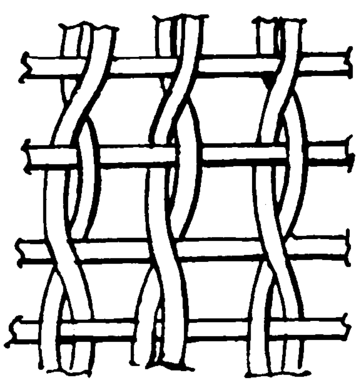


FIG. 3

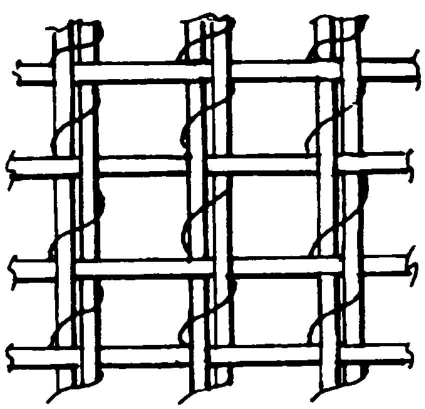


FIG. 4